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Contents for September, 1942

Women War-workers at Vultee Aircraft ..... *W. Gerard Tuttle* 82

If I Were a War-worker ..... *Robert A. Sutermeister* 96

Lockheed's Full Testing Program ..... *R. Randell Irwin* 103

Wartime Lighting, Part II ..... *C. E. Ferree and G. Rand* 107

BOOKS

The Dynamics of Industrial Democracy ..... *Clinton D. Golden and Harold J. Ruttenberg* 118

Washington Is Like That ..... *W. M. Kiplinger* 118

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Do You Expect to Have Women Help in Your Plant? If so, You Will Run up Against Unexpected Problems. Should You Have Female Supervisors? Will Men Workers Object? How Should the Women be Dressed? How Much Pay Should They Get? Vultee's Experience Gives the Answers.

Women War-workers *at* Vultee Aircraft

By W. Gerard Tuttle
Vultee Aircraft, Inc.

The induction of a vast number of women into war industries provides a subject that is as broad as it is long. Throughout the entire world, an increasing share of the burden of war production is being taken over by women.

The present conflict has truly been called a "civilian's war." In view of the mounting total of casualities among noncombatants in active theaters of battle and the prodigious total of those killed or maimed in England, in France, and in other European countries, it is not inaccurate to say that a woman in her kitchen has no greater protection from enemy shell-fire and bombs than have men in the fighting forces.

In the degree to which this fact is realized, women, as a comparatively new source of labor supply, have come forward to share in the effort for victory and a peace worth having.

More Than 50% Women Anticipated

It is my understanding that English factories have been able to employ women to replace men called into the armed services to the extent of about 50 per cent. Evidently the factory procedures in that country cannot be readily adapted to the capabilities of women workers, for there is every reason to believe that that figure can be exceeded in this country.

It is obvious that the rapidly increasing employment of women in practically all types of war-production jobs is having an important effect upon industry in this country, particularly since such a large percentage of all our industries now is engaged in the war effort.

As to what the producers of ordnance, of tanks, jeeps, explosives, and ships are experiencing in this respect, I am not in a position to say. Nor can I competently evaluate changes being evolved in the production practices of these industries as a result of their employing women shop workers. It appears not improbable, however, that the general trend of these changes throughout America's war industries is reflected in the changes which have evolved at Vultee. With these I am familiar, and it is assumable that most of the contributing conditions in each, such as increased volume and speed of production which we have encountered, obtain likewise in other war industries.

Vultee last month completed its first year of manufacturing experience involving the use of women on direct production jobs. We were the first military aircraft manufacturers in the United States to begin the employment of women in the shop.

First Use of Women Experimental

WE BEGAN this program largely as an experiment. Data available from other fields of industry appeared too unrelated to apply specifically to our case.

A survey of the situation was begun, in order that we might block out some rudimentary basis for our program. There were certain conditions which worked to our advantage.

First among them was the fact that Vultee held the largest unit order for military airplanes ever placed by the War Department with a single concern. Consequently our production system was being broken down to include a large number of routine, repetitive operations.

Job Simplification Aided

BECAUSE of this job simplification, it was concluded that no pre-employment training would be given the women to be hired. They would be drawn directly from allied lines of industry and be schooled in the routine of their new job by the foremen concerned.

During April of last year, Vultee put to work the first fifty women, using them in the radio and electrical subassembly department. Several were hired on preparatory jobs, such as masking, in the paint shop, and on the sewing of fabric covering for control surfaces and blind-flying hoods.

By May of last year, at the end of the first month of our experience in the hiring of women, our program passed beyond the experimental stage. Women, within that brief time, had proved conclusively that they were capable of handling a large number of the jobs involved in large-scale production of military aircraft.

This fact we learned substantially in advance of the appeal made by Sidney Hillman (then co-director of the OPM), that defense plants make an effort to employ resident women, in preference to attracting men from distant localities, with conse-

quent uprooting of entire families and their influx to crowded defense-production areas. The advantage, in terms of a more stable personnel to be obtained from following such a policy, already was becoming apparent from our experience. Our personnel turnover among women is extremely low.

Several hundred additional women have been added to the payroll in the ensuing months—many problems have arisen, satisfactory solutions to which havebeen incorporated in our personnel pollices.

With this in view, and on the basis of a recently completed survey, we have concluded that the present total of women employees in the plant can be quadrupled, if need be, and the total number of job classifications for which they are hired can be more than doubled. Considering draft conditions with an eye to which I may say the program originally was started, the advantage of this is obvious.

Reaction of Men One Problem

Our first problem was with the men. They resented what they considered to be encroachment of women upon their sphere. They sought to belittle the notion that women might successfully fill jobs similar to the ones on which they worked. Of further injury to their masculine pride was the fact that Vultee committed itself to the payment of wages in direct relation to the job done—making no distinction in wage scale between men and women.

Here, then, was a situation in which men found themselves working shoulder to shoulder with women, on similar jobs and receiving similar pay. Since there was little else they could do about it, the men awoke to the realization that the only way out was "up." For the most part, they began to train themselves for better jobs.

This reaction fitted admirably into the company's program of expansion. It was never Vultee's plan to replace men with women, but rather to employ women in order that available men could be released to fill jobs requiring greater capacity.

Spurring the men on to fulfill this expectation was the fact that the first few score of women employed began to do an excellent job. Almost immediately, they exhibited an adeptness for their new tasks. They knew, of course, that they were on trial and the desire to "make good" heightened their efforts.

First Women Model Employees

They became what might be termed "model employees." Their morale was excellent—they did not abuse privileges given them; there was no congregating in the restrooms; no smoking in forbidden areas.

The radio and electrical subassembly department in particular had been a continuous problem as long as men were employed there exclusively. Most of the tasks involved routine repetitive operations. Men quickly learned them, and, as quickly, became dissatisfied. They wanted more money than the job was worth. Failing to get it, they demanded transfers to other departments. Specifically, they lost interest in their work.

An instance of induced physical fatigue, resulting from such loss of interest, may be worth citing. One of the men in electrical subassembly had been using an air-driven wrench. He began to complain that the wrench was too heavy. Lifting and handling it all day was overtaxing his arm muscles. In so far as could be determined, he was sincere in his complaints, which became incessant. When a woman was assigned to his job and he was transferred to another, the foreman frequently took occasion to ask her if she could handle it—was it too much for her? She, on the other hand, was equally sincere in saying that she never gave a thought to the physical effort involved. Her interest was centered in proving her competence on the new job.

Such experiences as that focused attention on the fact that men, of a type worthy of retention on the payroll, naturally lost interest in their simplified jobs almost as quickly as the routine involved was mastered. Their dissatisfaction was merely an expression of unemployed capacity.

Men Rapidly Promoted

SINCE the company was pursuing a course of rapid expansion, opportunities for advancement to better positions were seldom lacking. By reason of this, our problem with the men practically solved itself.

Meanwhile, women were being inducted into the plant in increasing numbers. They were put to work in the machine shop, doing filing and burring. Then they were tried and found competent in the operation of drill presses, and on mills, hand-turret lathes, and similar tools.

But, within the first three-months, women began to take advantage of the situation. Their number had increased considerably and they realized the trial period was over.

They began to carry to an extreme the tendency of some of the men who had not recovered an interest in the job. The women began congregating in the rest rooms, or loitering there to chat awhile.

Up to that time, only foremen had been given the right to correct deficiencies in the women's conduct, and they had had very little trouble in doing it. But this situation was a "poser."

Obviously, the foremen could not enter the women's rest room. The situation became a bit delicate. A woman needed only to imply that her absence from the job was necessary and her foreman could do little about it, even though he had reason to believe she had deliberately abused the privileges reserved to her.

Matrons Aid Foremen

TO MEET this problem, our first matron was employed. She solved it in rather quick order, by entering the rest room and catching the girls there smoking or loitering to talk.

It was not difficult to make them realize that their abuse of privileges placed their jobs in jeopardy. And they wanted to keep those jobs. At that time, there was no other company to whom they might apply for similar employment. Nor could they return to former jobs in allied industries without accepting wages that, on the average, amounted to about 30 per cent less than they were getting at Vultee.

The situation was cleared up quickly, but it brought repercussions. The matron was a little tactless in her handling of the problem. We had been a little careless and lacking in forethought when selecting her.

As a first step, special rules pertaining to women were adopted. These rules now comprise a special section of the company's rule book. Care is taken to explain them to each new woman employee on the day she goes to work. A copy of the rule book, of course, is given her, so that she may refer to it as occasion arises.

As a second step, two new matrons were brought in to replace the first. Care was taken this time to select matrons who were mature, womanly women, capable of commanding respect, but tactful, considerate, and able to win their point by persuasion rather than by threats.

It was unnecessary to terminate any of the women involved in the foregoing incident, so readily did the presence of the two new matrons dissipate the aftermath of resentment against their predecessor.

No Supervisory Authority

OTHER than in dealing with infringements of these special regulations, the matrons have no supervisory authority. Each reports directly to the assistant superintendent of the departments assigned to her. And each, by her tactful enforcement of these regulations, has assisted the foremen in responsibilities naturally difficult for them to handle.

For instance, foremen make an awkward job of it when they have to tell a woman employee that the sweater she is wearing is far too tight. Nor is it easy for to instruct a girl not to use extreme makeup.

In carrying out dress regulations, it is far more satisfactory for the foreman to call infringements to the attention of the matron and let her take care of the matter for him.

Reversing the picture, women employees dislike having to ask their foreman for special consideration on account of their occasionally acute periodical condition in order to secure his permission to visit the plant hospital. Yet no employee is permitted to see the company doctor without a special pass. Women are not reluctant, however, to place their request with the matron, who can obtain a pass from the foreman for them.

In fact, these new matrons have so won the confidence of women employees that the latter voluntarily discuss matters with them that they would not otherwise have acceptable means of bringing to the attention of supervision.

Women Very Conscientious

THESE results, in turn, went far to modify an attitude toward women workers that had been apparent on the part of many of our foremen. Relieved of the irksome phases of their supervision of women, they were free to recognize more clearly the ability of their feminine employees. They found in these women, newly inducted into the military aircraft industry, a high degree of pride in being found competent on the job.

While foremen still look upon a woman with a hammer in her hand with some indulgence, they unhesitatingly rely upon women to do their work exactly according to instructions. The foremen realize that it is largely a lack of direct mechanical experience from childhood upward that prevents women from handling certain jobs with a facility equal to men.

But they recognize, too, that this very handicap makes women more painstaking in their efforts to fulfill the requirements of their job with absolute accuracy. Because the women themselves recognize their shortcomings, they exhibit less tendency to pass over minor errors in their work.

As an instance, they may be more completely relied upon then men to replace a rivet impropertly headed.

Time Out For Tears

BY REASON of the reliance they are able to place in their women employees, the foremen are inclined to minimize in their own mind the added burden of having to deal more tactfully with women than with men. Otherwise we might have greater objection from the foreman when a woman takes "time out for tears" because she has been transferred to another job.

It is necessary in such instances we find, to explain carefully to the woman that such transfer does not indicate incompetence on her part. It appears to be their tendency to feel when they are placed on another job that they were not fulfilling expectations on the previous one.

Other special considerations made in behalf of women include only minor changes in the usual procedure for induction of new employees.

The same application form is used, the same interviewers consider the applicants' qualifications and their required character references and letters of recommendations from previous employers. Both men and women are subjected to the same routine of fingerprinting and gathering of identification data. But separate rooms for physical examinations have been welcomed as an added facility.

Problems of Dress

WHEN the special dress regulations are explained to new women employees, recommendation is made that they wear the standard uniform, obtainable at the employees' store.

There is a point worth noting here, however; the first uniform adopted comprised slacks and blouse of a pattern that apparently imposed some restriction on their freedom of bodily movement. Women, normally accustomed to wearing dresses, dislike any apparel that binds or hampers them in unaccustomed ways. Furthermore, they will not like the uniform if the color does not do justice to their appearance. Nor do they like it if it makes them conspicuous should they need to do a bit of shopping on the way home from work. Women dislike being made to feel conspicuous.

If company insignia is sewed to the uniform, and is of such size and in such a position that it cannot be easily covered by a coat or jacket, or if the material and color of the slacks are such that they are readily distinguishable as being other than acceptable street wear, the majority of women will refuse to wear them because of the resulting occasions on which they are made to feel conspicuous.

Furthermore, a one-piece uniform appears to be more acceptable than the two-piece variety.

Should it fall to your lot to attempt the task of persuading women employees of your plant to wear a standard uniform, these points may be borne in mind with profit when selecting it.

Careful Induction

To return again to the point from which I digressed—that of inducting new employees—both men and women are taken in charge by the Employee Service Supervisor, who explains the company policies and other items contained in the rule book.

Thereafter, the women are introduced to the matron of the department in which they will work, while the men continue on a tour of the plant conducted by the Service Supervisor.

The matron explains further the special regulations applying to women.

When the foregoing provisions have been explained and discussed with new women employees by the matron, the latter conducts them to their various departments, acquaints them with the location of rest rooms and first-aid units, then introduces them to their foreman.

Experience has shown it is preferable not to parade new women employees through the plant in groups on a conducted tour.

While the need for making these provisions in behalf of women was being learned, experimental data on their performance on the job was being gathered and compiled. It has led us to rather definite and far-reaching conclusions.

To begin with, factory jobs for women must be tailored to women.

By reason of general usage, the tools and facilities of American factory jobs largely are designed to be handled by men.

Jobs Tailor-made For Women

IT DEFINITELY was in Vultee's favor that the hiring of women was started when production jobs were being simplified to meet the needs of fast, quantity production. Consequently it was a comparatively simple problem to so plant many of the jobs that they can be said to be tailor-made for women.

Throughout the electrical subassembly department, most operations are arranged so that women may sit at their work, with all materials and tools close at hand.

Special jigs were added to hold small tools, such as drills, so that women could concentrate on employing more effectively their proven capacity for repetitive operations requiring high digital dexterity. They excel at making every movement of the hands count.

While I cited earlier an incident in which one of the women failed to feel fatigued from having continuously to lift an air-operated wrench, the actual lifting and handling of it obviously detracted from her potential efficiency.

Unlike the man whom she replaced, she, as a woman, had the capacity to withstand the monotony of even more simplified repetitive operations.

To have suspended the air wrench from a counter-balanced support for him would have served merely to heighten his boredom with the job.

As for the woman who replaced him, she now handles two such counterbalanced, air-driven wrenches, one in each hand, and with them simultaneously tightens two lugs at the same time, instead of one as formerly.

Value of Job Classification

THIS retailoring of jobs to suit them for women has extended amazingly the list of classifications in which women have proved themselves proficient. But the extent to which it could be carried struck definite limitations when it was sought to segregate women into sections of the plant separate from those in which men were required.

In so far as was possible, that effort was carried out. But efficient warplane production, by a streamlined flow from raw stock to fly away, without backtracking does not permit such an idea to be carried very far. Many of the jobs for which women are admirably suited must be carried out by them shoulder to shoulder with men.

It was essential, therefore, from the outset, that men and women be treated with equality. With but the few exceptions mentioned (and those desirable to best efficiency of both), this policy has been carried out explicitly. Results have been most encouraging. Having proved their ability to hold their jobs, being paid on the same wage scale and treated the same as men, women began to react to their own competence. They gradually began to accept an equal share in plant activities.

Cardinal virtue among the latter is their participation in the Vultee employee's suggestion plan. Ideas submitted by women for improvement of products and manu-

facturing procedures have increased measurably of late. None of their ideas has been rejected by the Suggestion Plan Committee because it was found impractical.

Suggestions Parallel Those of Engineers

OF HIGH interest is the fact that many of the women's suggestions are found to parallel developments already being undertaken by the production engineering department. In other words, Vultee's women employees have gained such a grasp of their new situation that they already can view their jobs in perspective—recognize wherein procedures fall short, from their standpoint—and suggest improvements that are practical.

Women's suggestions repeatedly have led to their own increased efficiency. They have applied their knack for contriving ways of doing things more quickly and with less effort. One has designed a new type of rack on which light parts are conveyed from subassembly to the paint shop and supported during paint spraying operations. Another developed a means of sewing tail wheel boots that saves valuable material and time. Yet another drew upon her previous industrial experience in a bottling works to suggest the use of a glue-spreading machine to replace the former method of applying adhesive with a brush. By doing so, she mulitplied her own production three times. A woman employee in the paint shop developed a means of masking which saves masking tape and can be used more quickly.

While this newly acquired self-confidence was beginning to find expression, another factor, which favorably affected it, was being felt noticeably. From the time last year when announcement was made that Vultee would begin hiring women on direct production jobs, a considerable amount of publicity has appeared. As we progressed through each stage of our program, newspapers, magazines, the radio, and newsreels have kept pace with our progress.

Type of Women Preferred

TO THOSE of you who may from time to time have been exposed to some of it, it is obvious that much consideration was being given to the selection of rather a high type of woman shop employee at Vultee. For instance, the percentage of women now working in the plant who are married is 46.57. Of the large number with dependents, 67.80 per cent support children; 27.29 per cent are single and 14.42 per cent are divorced. Only 7.66 per cent of the factory women are separated and 4.66 per cent are widowed.

Preference is given to women applicants of 22 years of age or more. There is no top limit of age. At present the oldest among them is 59. As to the average educational background of Vultee shop women, 46.06 per cent have completed 4 years of high school. This includes the three who have a college degree. One and forty-three hundredths per cent failed to complete more than eight years of school.

From this it may be seen that Vultee's feminine plant personnel compares very

well with the working section of the feminine populace of a good, sound American community.

These facts about Vultee women employees, when widely broadcast and further related conversationally among friends, attracted a continuously ample number of women applicants of similarly high caliber. From these we were able to make selections with even greater care.

Meanwhile, data gathered on their performance on the job of women who had been selected principally on the basis of their previous industrial experience led us to question whether or not we might profitably abandon that tack in many instances.

Previous Factory Experience Unessential

IN THE few cases tried, our experience shows that women with good background, who exhibit a high aptitude, can be put directly on the job and quickly trained with better results than could be obtained if they were selected solely on the basis of their previous experience in allied fields.

In the first place, such applicants do not have to unlearn certain attitudes and habits of work and they are far more apt to express enthusiasm and initiative on the job.

If we could find a dependable means of selecting by aptitude simplified jobs in subassembly, along the powered monorail final-assembly conveyor line, and in receiving, inspection could be filled by women from unallied fields of industry as contrasted to the need for training and experience for such jobs as welding and machine chop.

Mechanical aptitude tests, Johnson-O'Connor Pin Block, Stenquist Mechanical Aptitude Test, and the Minnesota Manual Manipulation Test were tried. Foremen of the various departments selected the 10 women they considered to be of top-flight efficiency, and likewise the 10 whom they rated (to use their own language), as "hanging on the ropes," in so far as their continued employment at Vultee was concerned. Two representatives of the U.S. Employment Office put the 20 women, in mixed order, through the tests. Results coincided with the foremen's judgement with but one exception, and that case, when traced down, was the exception which proved the accuracy of the tests. She was a new employee, having been inducted but a day or so prior to the time her foreman rated her in the inferior group. During the two weeks which had elapsed between then and our checking into the matter, she had oriented herself in her new situation and already was employed in one of the highest-skilled jobs in her department.

Hiring Through U. S. Employment Service

SINCE almost all initial interviews now are conducted at the office of the U.S. Employment Service for all aircraft factories of the Los Angeles area, I understand

that office is now preparing to make regular use of these aptitude tests on all applicants intended for reference to Vultee.

The question most frequently asked by visitors at Vultee—one which, frankly, gave us some worry at the outset of this program of hiring women—is beginning to find its answer in the results of our present trend toward evaluating the applicant herself, rather than entirely by her experience.

Everyone seemed certain that we would have a moral problem on our hands if we worked women and men shoulder to shoulder in the plant. We were not entirely unconvinced ourselves.

Of greater worry to us was the probability that this condition might result in frequent transferring of an employee's concentration on work to his or her fellow employee. I am happy to state that, since the very early stages of the women's hiring program, we have encountered no more difficulties of this sort in any of the shop departments than among office employees. Emphasis on evaluation of the character and background of new employees has raised us above that pitfall.

I have stated that it was never the intention at Vultee actually to replace men with women. Instead, it was our dual objective to release them from the doldrums that resulted from job simplification and to make better use of the capacities of those among them whom the draft did not take.

Men Supervisors Found Best

Conversely, only men are used for supervision at Vultee. This too has proven definitely advantageous. Women resent taking orders from women, but readily accept direction from men competent to supervise them. Under this condition they accept supervision more readily than men.

This fact is borne out by our experience with them in defense training classes. A substantial number of our feminine personnel regularly attend these classes. They learn more slowly than men, because they learn meticulously. They ask interminable questions and practically exhaust the possibilities of each step taught them.

In this they express decidedly less tendency than men to skim over details as a result of hasty evaluation of themselves as being basically superior to their instructor.

Men are prone to take this attitude in spite of the fact that must be obvious even to them that they are not yet as well trained in the subject being studied.

To sum up, employment of women at Vultee functions now, on the basis of a year's experience, with recognition of the following points which make for its definite success:

Factory jobs have been tailored to women's natural proclivities, enabling them to employ the high digital dexterity in handling repetitive operations in which they excel, and to express the same efficiency as they do in their own fields.

Equality of treatment and remuneration on the same scale as men has won from women at Vultee a favorable reaction to their own competence. This, in turn, spurs

their initiative. Results are expressed in terms of suggested manufacturing improvements, that already have been cited.

Furthermore, those among them who have membership in the unions represented at Vultee share in the activities of those organizations. In view of Vultee's policy of paying women equally with men on the basis of the job done, unions readily accepted the Company's program for hiring women. And Union Grievance Committees now include women representatives.

Upgrading Program Develops Pride

TAKING pains to evaluate the individual in terms of her basic character, coupled with an analysis of her mechanical aptitude, has gone far to set a favorable pattern of shop conduct. Furthermore, it has resulted in a heightened morale and efficiency among both men and women. We have former lingerie salesgirls, school teachers, dress models, housewives, show girls, business-school-graduated girls turned shop workers, novices, and those with previous related industrial experience working together in the plant with men of as many dissimilar backgrounds.

Their tacit acceptance of each other is based on individual competence on the job, but, beyond that, the upgrading of the plant personnel, effected by careful selection of applicants from the standpoint of character, has developed pride among employees in being recognized as Vultee workers.

Finally, exclusive employment of men in supervisory capacity actually has eased the friction usual between those who give and those who take orders.

A condition frequently encountered at Vultee, which would have been wholly astounding a brief twelve months ago, leads me to believe that a trend is building up that may reach unforeseeable proportions.

Examples of Progress

A SUBSTANTIAL number of women, now lucratively employed as private secretaries elsewhere, have applied for shop jobs at Vultee. In fact, many members of our own office force have made known their willingness to transfer to direct production jobs.

While a part of this tendency is accounted for by existence of war conditions and a prevalent patriotic desire to take a more direct part in the effort for victory, there undoubtedly is a further factor involved.

Some light is thrown upon this by the advancement achieved by certain of our women employees, from mediocre shop jobs to increasingly higher brackets involved in direct war-plane production.

As an instance, a girl of 23, with college background and considerable initiative, has advanced from paint-shop helper through successive steps to her present position as process planner in the tooling department.

Another woman is successfully holding down a job as a manufacturing planner.

Yet another woman, whose background is quite unusual, has advanced from the comparatively simple, routine job of magnetic inspection to a position in the production department.

Women definitely are coming into their own in the handling of direct production jobs. Those whose natural aptitude was less suited for the types of jobs formerly open to women now are finding opportunity to prove their latent ability. It reasonably may be concluded from this that a full new field of endeavor is being opened for women as a result of wartime necessity, and that women are proving themselves capable of meeting its requirements. Such opportunities have not heretofore existed.

Factory Girl Gains Social Standing

Perhaps this very lack of opportunity caused a rejection on the part of women—somewhat in the manner of a psychological defense mechanism—of the notion of an industrial-production career for themselves. Now, however, with the pressure of the war emergency popularizing the notion of war jobs for women, a directly opposite trend has developed. The shop girl no longer is looked down upon socially as one who cannot find a better means of earning her livelihood. Existing wages in the aircraft industry, perhaps, have had considerable effect upon this change of attitude, but beyond that, the ability to hold down a job in direct production is gaining an equal importance in women's scale of values with that accorded it by men. Once fully established, it is probable that this trend will continue beyond the war effort.

Progress toward Supervisory Rank

As women in direct production gain competence and skill through experience, it appears probable that they may offset the disadvantage inherent in such relationship and we shall find them in supervisory positions in the factory. Therein, they will be accepted equally with men on the basis of their individual competence.

In other fields, such as communications, women for some time past have been included in supervision. Pressure of the present emergency may do much to hasten their acceptance in such capacity throughout the war industries. Admittedly, this looks toward a reversal of the present policy at Vultee of employing only men in supervision. There are three salient factors involved. One is the pressure of war emergency. The second will be the number of years of experience it will take for women to acquire competence equal to that of men now in supervision, who have spent their entire working lives in direct production, and their ability to meet peculiarities of the problem that will exist when women are given foremanship over women.

A third modifier, and an important one, will be the degree of job simplification that will develop from industry's increasing mass-production efforts.

If I am right in assuming that the effect of women being inducted in large numbers into war industries is reflected by results at Vultee, it seems not unreasonable to

point out that development of this new source of war labor supply—by which half, or perhaps more than half, of direct war production may be carried (if that becomes essential to victory)—may culminate, sometime in the future, in an industrial revolution.

Women in industry, I believe, are here to stay.

Presented at seminar on "Women in War Industries" at the First Southern California Management Conference, held at the California Institute of Technology, Pasadena, California.

Ordway Tead Says That the Work of a Personnel Department Includes Being "An Interpreter to Management of Worker Attitudes, Individual and Collective, Normal and Pathological, and a Balancer and Reconciler of the Claims of Production and of Personality."

If I Were A War-worker

By Robert A. Sutermeister
University of Washington,
Seattle, Washington

In spite of repeated admonitions, some managers today seem to make no effort to apply common sense to the problems of workers. They attack loafing on the job, tardiness, absence from work, lack of patriotism, eagerness to quit jobs for higher pay elsewhere, and expression of petty grievances, without attempting to understand the causes and reasons behind them. May I invite management of this type to put itself in the worker's shoes, and to study the ways in which a war worker (or any worker) can be encouraged to *want* to be efficient?

Four Executives in War Industries

Within the past few weeks this truth has been impressed upon me as a result of conversations with several employers in war industries. A personnel officer, taking me through his airplane factory, asked me what I thought of the uniforms for women. They were plain white coveralls, straight-cut, unattractive, and almost certain to be unsatisfactory from a woman's point of view. I asked who decided upon them and he replied that he had. I asked how the women liked them, and he replied that there were a number of complaints. Imagine a mere man deciding a question of such vast importance to women without even getting their ideas on the subject!

A sales executive ushered me into his war plant office. After showing me a map of his firm's operations, he pointed out with pardonable pride a large picture of a beautiful airplane in which the product of his firm was utilized. I would have been blind not to notice the feeling of satisfaction and pride which he took in telling me

about it. Immediately I inquired whether the workers in the plant had a picture like that. The answer was no. What tremendous possibilities management sometimes overlooks for building employee interest and morale and increased efficiency! If this firm would reproduce pictures of the plane and distribute one to each employee, my guess is that half of the pictures would find their ways to positions of honor in the employees' homes.

Wise-cracks and Froth

ANOTHER executive had just discontinued a suggestion system because he had found that employees were occasionally putting "wise-cracks" in the suggestion boxes. The boxes were scattered throughout the plant and served as convenient receptacles for waste; the suggestion system had been given insufficient attention and publicity, with the result that many workers did not understand the purpose of the boxes; and the few valuable suggestions which had been made were forgotten when the ridiculous ones were received. The situation made me think of a firm firing its best salesman because the shipping department sent out defective merchandise to the customer!

A fourth executive was reluctant to start a labor-management committee because he felt it would spend too much time on "froth" before getting down to "real" problems. Further discussion revealed that "froth" to this executive meant those very insignificant grievances which employees sometimes get, complaining that there are no tooth picks in the lunch room, or that the company store has exhausted its stock of tobacco. Both of these "very insignificant grievances" came dangerously close to causing costly strikes.

Hiring and Introduction to Job

IF I were an applicant for a war job today, I would want to receive reasonably prompt attention from the employment office; if I were employed, I would want the important company rules explained to me and other rules furnished me, perhaps in booklet form, for reference and study when I had more time to absorb them. I would want to be taken personally, and alone, to be introduced to my foreman (not along with twenty other new employees, for then I would feel more like an additional sheet of steel or one more bucket of rivets being brought into the plant, rather than like a living person with thoughts and feelings of my own).

I would want my foreman to appear glad to have me in the department, and to make me feel as if I really had a contribution to make to the war effort. I would want someone to break me in on my job so that I thoroughly understood not only *what* I was to do, but *when* and *how* and *why* I was to do it. (If I don't understand why I'm doing a job in a certain way I am likely to lose interest in it quickly, and reduced interest means reduced efficiency.) I would want my foreman, and also a representative from the personnel department, to stop by and see how I was getting

along, to give me the opportunity to ask questions, and to make me feel that my addition to production, though small, really was important.

I would be interested in my physical surroundings and working conditions. I would expect to find a plant that was safe, clean, well-lighted, and well-ventilated. (If it weren't, I would be tempted to get a job in a plant which had these advantages.) If my machine were a dangerous one, painting its moving parts in bright colors and installing fool-proof safety devices would improve my morale and efficiency. But as I settle down into my routine operation day after day, the first important impressions, if they have been favorable, fade into the backbround; and I would attach more and more importance to the treatment I receive from my immediate foreman.

Proper Supervision

I WOULD want my foreman to realize that, as far as I am concerned, he *is* the company. My sole contact with the employer is through the foreman; it is his job to know each of his workers as intimately as, in former times, the manager of a small business knew all his employees. From my point of view it is inexcusable for him not to know my name. I feel he should even know my nickname, and the fact that I have two boys in high school, and that raising pigeons is my hobby. (Unless he knows these things, how am I to be differentiated from the ten thousand other workers in the plant?)

I would want my foreman to know not only the technical side of his job, but also the human relations side. He should be able to see my viewpoint toward things; he should command my respect (otherwise I am not going to *want* to put my best foot forward). His manner and the tone of voice he uses in talking to me are very important. If he does not naturally have the "knack" of being a good supervisor, I hope he will attend some classes in foremanship training and learn how to "lead" his men rather than to "boss" them.

Foreman Should Watch His Step

IF MY foreman is going to command my respect and call forth my best efforts on the job, he is going to have to "watch his step" all the time. He is going to have to remember that I have pride, and he must take care not to injure that pride—not to make me feel small, not to embarrass me at my job. He will have to treat all of us workers fairly and equally; there can be no favorites. Promotions, transfers, wage increases, quantity of work assigned, difficulty of work—all these must be on a fair basis. Service records should be kept and reviewed frequently. (Otherwise, if I do excellent work, I may feel that it is not properly rewarded; and why should I continue to do an outstanding job when there is no benefit, either financial or non-financial, to be derived from it?)

I would want my foreman to give clear orders and to follow them up. I would want him to know just what calibre of work I am capable of doing. If my perfor-

mance is superior, I would like a pat on the back (otherwise how do I know it has been noticed?). If my performance is poor, I expect to be reprimanded for it (otherwise, if I am allowed to "get by" with mediocre work, I feel that my foreman doesn't know and doesn't care whether I do a good job or a poor one). But if I am reprimanded for poor work or for any other reason, I would want my foreman to do it without hurting my pride and in a constructive way, with suggestions for improvement in the future. (If he reprimands me publicly in front of my fellow workers, he humiliates me and I will lose my respect for him.)

I Would Want to Know My Output

If my foreman really wants me to be interested in producing tanks, I would like him to give me a daily record of my output so that I would know whether my efficiency is increasing. (Otherwise my routine job may become very monotonous and my efficiency may lag.) I would like to see a production chart for our department and for the whole plant, so that every night when I go home I would know how much closer we are to beating the Japs.

My interest would be increased if I were conducted through the other departments and if I were permitted to see the final product—the tank that we are all cooperating to produce. If pictures of our product in action were posted on the bulletin board, and if wires telling of its performance in the field were also posted, I would feel a more direct connection between my small part in production and the ultimate goal for which we are all striving.

All these things, and hundreds of others the company could do to stimulate my interest and raise my morale, would automatically increase production. (But if the president of the company keeps all the production records and the pictures and the telegrams in his office, *he* will want to work harder, but that has no effect on *me*.)

My Pay Problem

I would like to feel that my pay is equal to the pay for other defense workers. But if it is lower, I am still going to give my best work provided I have a lot of respect for my foreman. And if the company is sincerely trying to get me wages equal to those of other defense workers, and *if I know* the company is trying to do this, I feel they are "going to town" for me and I won't let them down on production. Even if they don't succeed in getting the wage raise, the very fact that they tried, that they are really backing up their men, will mean a lot to me and will make me glad that I am working for them! (However, if they don't try to remedy an inequitable situation, and if I don't have much respect for my foreman, I will be strongly tempted to quit for higher wages.)

I would like to have an opportunity to communicate personally with management. Shop stewards and union committees are all right in their places, but I want a chance to talk to my foreman or superintendent about *my* work and *my* chances for advance-

ment, and other matters which concern *me* alone. I don't mean the "open-door" policy of the president, either, because I would never feel at ease to go in and talk to him. I would welcome a systematic method of periodic interviews initiated by management, so that I would regularly have a chance to get things off my chest. Maybe I have a grievance, or maybe I just think I have a grievance; and a friendly, frank talk could probably clear up the whole matter. (Otherwise a minor grievance, or a mythical one, may assume an importance way out of line with its real significance, and may cause me to quit my job.)

I Should Like My Questions Answered

I WOULD want a foreman who realized that, working eight or ten hours per day, I am bound to have questions arise, and who would listen to them patiently. If he can't answer them himself, I would want him to find out the answers and then pass them on to me. (If he brushed aside my questions, or if he merely replied, "It's against company policy—that's the reason", I would feel that management did not want me to be interested in my work, and I would not even try to produce at maximum efficiency.) I would occasionally have questions about the company and its operations; if no one would answer these for me, I would be forced to draw my own conclusions, and my ears would be more receptive to rumors about the firm than I would wish them to be. Absence of facts frequently promotes rumors and suspicions.

If my company is really interested in maximum production, it should consult me when changes in my operation are contemplated, for, after all, I quite likely know more about my job than anyone else, and I can doubtless give some valuable suggestions. Moreover, I may have some ideas on other things around the plant, and I would like a suggestion system or some other means of conveying my ideas to management. I would expect management to adopt a positive attitude toward my ideas and try to see how they *could* be used. (If management adopts a negative attitude and seems always ready to give me several reasons why my idea *can't* be used, I will be discouraged and will make no further suggestions.) However, if I am given an adequate reward for my useful suggestions, I will be stimulated to make additional ones which will increase efficiency still further.

Conditions of Maximum Effort

IN SHORT, if I were a defense worker today, I would want to produce as much as I could *only* if I were *treated as an individual*, separate and distinct from every other individual in the plant. I don't mean that the president or the personnel manager or even the superintendent would have to know me by name, but some responsible person, probably my foreman or my straw boss, should know me intimately. He should give me credit for all the work I do; he should push me along if I deserve advancement; he should make me feel that my individual efforts are recognized, are important in the war effort, and are appreciated by management.

Without this feeling that I really count, there is going to be a strong temptation for me to follow the example of some of the other fellows and arrive at work late (because I won't be missed), or to loaf on the job (because my boss never knows whether I turn out 10 units a day or 100), or to quit for higher wages (because wages seem to be the only satisfaction I get from a job).

A Plea to Management

TO SUGGESTIONS of this sort, management sometimes protests: "All that you say may be true, and we realize that, but we're building tanks, and we don't have time for all those things now. A war is being fought. Our problem is one of production and not of human relations". So, pleading lack of time, management frequently rationalizes the situation and doesn't try to understand the workers. As a result, the workers don't have any desire to be efficient. Production lags.

Management is constantly stimulated by big ideas. It has momentous decisions to make; it has materials to buy; it has transportation tangles to straighten out; it has telegrams to answer; it has millions of dollars to spend. It gets reports of the tanks' performance; it has pictures of the tanks in action; it knows the progress of production. It gets chills down its spine and the thrill of participation in the grand cause! But these stimuli are not shared with the workers—and with the workers is where they can do the most good!

Where management, voluntarily or through government pressure, has taken the time to consult the workers, and labor-management committees have been formed, such knotty problems as tardiness, absence, stealing, employment of minorities, loafing, handling of suggestions, and other important questions have been attacked intelligently and effectively. Cooperative committees of this sort can work out solutions for many problems that management alone would have great difficulty in handling.

11,000 Tanks Beat 10,000

MANAGERS! This is a plea and a challenge! Look at your turnover rates and find out *how many* employees are quitting! Look at your exit interview forms and find out *why* workers are leaving your organization! Stroll through the plant and ask ten workers, selected at random, what they think of their jobs! Ask your foremen whether the workers are producing at maximum efficiency! You will learn whether or not your men feel that they are individuals or just a group of people called "labor". Then take the time to correct any unsatisfactory situation; if possible, hire a full time expert to study the attitudes and feelings of the employees and take such steps as may be necessary to build up morale and efficiency. The salary of this additional executive may easily be earned one thousand times over in terms of increased output.

If one nation has 10,000 tanks and another 11,000, it is not so much the first 10,000 which are important, but rather the last 1,000 or the excess which the one na-

tion has over the other. It is this additional or marginal output we must have to assure our success in winning the war. If we can increase the efficiency of the workers we will secure the additional output. But the worker himself must *want* to increase his efficiency. The desire must come from within him. He must feel that his contribution, small as it is, is vital. He must feel that he, as one man in a plant of ten thousand, is an individual, recognized and appreciated by management.

The individuality of each worker must be stressed! His desire to increase production must be allowed to live! The *least* that management can do is to set up the external conditions which will not discourage the worker from *wanting* to be efficient!

Based upon a talk given at the University of British Columbia in a Personnel Administration Course sponsored by the Canadian Department of Labor.

Rapid Expansion of a War Industry Leading to the Hiring of Large Numbers of Workers, Many Without Previous Factory Experience, Has Been Found to Result in Many Discharges and Quits if There is not Installed a Sound Use of Psychological Methods.

Lockheed's Full Testing Program

By R. Randell Irwin
Lockheed Aircraft Corporation

In 1937 Lockheed found that hardly two out of three new employees developed into satisfactory workers. Many beginners were unable to adjust themselves to the team method of making airplanes. They were too fast or too slow, or they could not get along with the other members or the leader of the small, highly co-ordinated teams. Many of these beginners quit or were terminated.

Lockheed decided that the time to solve these problems was before the workers were hired. Employers had for some time been testing the skills and aptitudes, the intelligence, and the health of their workers. But still there were always many who quit or were fired. The cause of 80 per cent of employee misfits was temperamental maladjustment.

Re-evaluation of Active Employees

A testing program was designed that would supplement the regular interview and selection practice. It provided the interviewer with objective test measures to aid his personal judgment. The new procedure helped in the selection of employees who fulfilled certain requirements of intelligence, mechanical or trade aptitude, and temperament.

The program was used not only for pre-selection but for re-evaluation of active employees. Misfits were tested, the results diagnosed, and corrective procedures suggested. Men of unusual promise were tested and supervisors picked. Wherever improvement had taken place, it could be measured, and proper use was made of it.

Evaluation of Applicants

LOCKHEED now gives all qualified applicants at least two tests: the Otis Test of Mental Ability and the Humm-Wadsworth Temperament Scale. Job specifications also may call for one or more of the trade, mechanical, or clerical aptitude tests.

The intelligence test is used as an aid in the placement of an applicant. Certain jobs demand men whose intelligence falls within a given bracket. Some applicants are too smart for certain jobs; others do not have sufficient mental alacrity to keep up with a function. Thus, though an individual's intelligence is apart from his temperament, it is a key in his final placement within the company.

The temperament scale as used by Lockheed attempts to *predict* the behavior of the applicant in any placement that the company might make. The scale is composed of 318 questions requiring a "yes" or "no" reply. These disarmingly worded questions represent a breakdown of temperament into five fundamental components: self-control, self-interest, emotion, imagination, and inspiration. Too much or too little of any of these factors usually shows why an employee does not work out at a job.

No one of the components should be judged by itself, but rather in its interrelationship to the other components and to the validity of the responses. The responses themselves have weighted values to the degree that they indicate tendencies toward any of the fundamental components. These "raw scores" are totaled and recorded on a "Profile" or Psychograph which gives a visual picture of the man's temperamental assets and liabilities in terms of "strong," "borderline," or "weak" values. The varying proportions of these values are what make people differ. From these values, Lockheed's temperament analysts measure the disposition and mental well-being of its applicants and predict their behavior under placement conditions.

Use of Trade Tests

WHEN the background of an applicant warrants, trade tests that would utilize his experience are given. The trade test attempts to measure the knowledge of the applicant so that when his test score is weighed with his experience he may be placed as a learner, junior, senior, etc., or eliminated as a trade bluffer. Clerical aptitude tests were devised that would give objective prediction for the routine filing job or the most exacting secretarial position. The results of these tests are at once diagnostic and comparative. A woman hired as a clerical-typist might improve her shorthand and typing, take the test at a later date, and become a stenographer.

Some of the Lockheed trade tests measure ability and achievement along skilled lines; others test for trade aptitude in any of several fields. A good garage mechanic might have some experience with the tools of a machinist. Since the employment market has been almost entirely drained of man with aircraft experience, it was hoped to bring men with allied experience into the industry with a minimum of training.

Criteria of Employee Growth

THE tests are frequently used as diagnostic criteria of an employee's growth or lack of growth at any point in his tenure.

When the company intends to go to considerable expense giving an intensive apprentice-training program, certain standards can be set up by which trainees can be selected. Thus, a highly selected group can be provided which will be physically, mentally, and temperamentally fit for specialized service.

Workers who go stale on the job can be re-tested and have a heart-to-heart talk with counselors. Readjustment usually follows. The employee has become aware of the assets and liabilities of his temperament. Nearly always he is quite relieved to get something off his chest; at least he makes a genuine effort to correct his fault. The diagnosis may show that a worker is on a job for which he is temperamentally unfit. The day-dreamer who can't keep up on a speed operation might have a quality that would work out quite well in the drafting room where he could project himself away from his surroundings and whip a problem. A diligent worker with an aptitude for blueprints might do well enough on the drafting test to be upgraded into the drafting room.

One of the key advantages of testing is its help in the selection of leaders and supervisors, men with the capacity to get along well with those under them, command their respect, and co-operate to get the job done thoroughly and pleasantly.

Results

SINCE 1937 Lockheed has tested almost 300,000 applicants, and from this pool selected its present personnel.

The company seldom employs a man or woman even in executive capacity without first giving the tests. Nearly every time an applicant has been employed in spite of adverse test results, the company has regretted it. Lockheed in the face of national emergency has had to fill many highly skilled jobs with men whose tests would indicate undesurable temperament. It is not surprising, then, to know that two out of every three workers that the company had to terminate in 1941 had shown adverse test results. Yet the rate of turnover for Lockheed is low as compared with the industry average.

Bright Eager Men and Women

WELL-BALANCED employees get along well together, work without dissention in the teams that are necessary in airplane building. Tests help to redeem a man outgrown by his job. When a man has a "beef," facts are substituted for opinion. An unbalanced trouble-maker can usually be weeded out before he is hired.

Apt employees increase production, so that Lockheed's production per man is high. Adjusted employees readily adapt themselves to the pressure of the present emergency.

Training costs per man have been decreased by testing applicants with allied experience and fitting their practical knowledge to jobs in the aircraft industry. Bright, eager men and women with motor co-ordination and stamina make excellent learners, progress rapidly, and help keep the morale of the employees at high pitch.

Lockheed is proud of its present personnel which has been hand-picked by the criteria of experience, temperament, and fitness.

Test Forms Utilized

Basics

Humm-Wadsworth Temperament Scale, Doncaster G. Humm Personal Service, Los Angeles, California, Copyright, 1934.

Otis Self-Administering Tests of Mental Ability, Higher Forms A, B, and D, World Book Company.

Mechanical Aptitudes

Johnson O'Connor Wiggly Block, C. H. Stoelting Company, 424 North Homan, Chicago, Illinois.

Minnesota Manipulative Tests, Educational Test Bureau, Inc., Minneapolis or Philadelphia.

Clerical Aptitudes[1]

Lockheed Clerical Test
Typing
Clerical-Typing
Stenographic
Filing

Trade Tests[1]

Accounting
Blueprint Reading
Drafting
Final Assembly
Final Assembly—revised
Lofting
Machinist
Patternmaker
Precision Assembly
Sheet Metal Assembler
Sheet Metal Worker
Template Maker

Portion of paper presented in seminar on "Selection", at the First Southern California Management Conference, held at the California Institute of Technology, Pasadena, California.

[1] The trade tests and the clerical aptitude have been set up and standardized by the Lockheed Testing Division and are not available for circulation.

The Fine Tolerances and Exact Measurements Required in the Production of Airplane Engines, Guns, Shells and Instruments Used by Our Armed Forces, Plus the Long Hours of Labor and Night-work Require that To Obtain Maximum Efficiency Great Attention Should be Paid to Proper Lighting and the Care of Eyes.

Wartime Lighting, Part II

By C. E. Ferree and G. Rand
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Color and Composition of Llght in Relation to the Blackout

In the selection of a color for a protective night light the eye factors as well as power to penetrate the external atmosphere should be taken into consideration—namely, the comparative sensitivity of the eye to colored lights at very low intensities, visual acuity at low intensity, and the adaptation factors. Principally because of the eye factors deep red has recently been recommended as superior to the formerly widely-accepted dark blue light. The question is intricate and interesting and in its broader aspects is still an open one. It is extremely interesting in its relation to the visual functions and the practical applications are of course important.

Deep red would hardly be acceptable as a night light for the illumination of many interiors, for example the lighting of hospitals. As a night light for hospitals we have used with considerable satisfaction light approximating the color of a low-brightness kerosene flame. This is not too unpleasant and is distinctly somnolent. The possibility of using heavily frosted, colorless bulbs should not of course be ignored. In fact we believe that a comparison of test results will show in their favor. However, without the use of color it is difficult to get light of sufficiently low intensity with the lamps that are available.

Blue Lights

As to the suitability of blue as a color for nighttime protection, it should be kept in mind that dark blue is the least distinguishable from dark gray and black of any of the shades of color, and that the illumination of an interior with blue light

by a suitable regulation of intensity and hue can be given a dim moonlight effect which differs little in color from the exterior illumination on a moonlight night. Further, even if the brightness of the colors is selective to intensity and blue is seen as relatively lighter at low levels of intensity and with a dark-adapted eye than are the colors in the opposite half of the spectrum, this subjective effect can be compensated for by reducing by a corresponding amount the intensity of the blue light.

Our thinking on this subject should, therefore, not be confused by too serious a consideration of the Purkinje phenomenon. Of the colors, red perhaps differs most in quality from black and for that reason red light stands out most vividly and strikingly from its background on a dark night. This is doubtless one of the reasons why red is chosen as a danger signal at night and might be offered as a very important reasons for not using red as a blackout or protective light in wartime. On the other hand, in favor of red the photochromatic interval should be taken into account. That is, below the threshold of color over a small range of intensity red light is not sensed as colorless as is the case with the other colored lights. The question also should be raised of the relative visual acuities for blue and red light at low intensities.

Arguments Against Use

AGAINST the use of blue light the argument has been advanced that the eye is at a disadvantage in focusing blue light. One controversialist has even said that the eye can not focus blue light. With respect to focusing the facts are: The emmetropic (normal) eye focuses parallel rays of blue light (i.e., objects at a distance of 20 feet or more) slightly in front of the retina. At some point nearer than 20 feet the rays diverge sufficiently to focus on the retina. This may be called the far point for blue light. For still nearer objects until the near point of vision is reached, the rays diverge progressively more and more, and require the lens of the eye to adjust (accommodate) for the respective distances. The near point for blue light is closer to the eye than for red, i.e., objects can be seen nearer the eye for blue than for red light.

The focal point for parallel rays of red light for the emmetropic eye is behind the retina. For all distances, therefore, the eye has to accommodate for red light. The comparative situation, then, is (a) that for blue light the emmetropic eye can not focus for objects at a distance of 20 feet or greater, and for red light accommodation is required for objects at all distances; and (b) that the eye can see objects closer with blue light than with red light.

Further, for uncorrected myopes (near-sighted) the eye with respect to focusing is better off with red light than with blue and for uncorrected hyperopes (far-sighted) the converse is true—the eye is better off with blue light than with red. These conclusions based on the physical situation are borne out by the results which we have obtained on visual acuity and speed of vision with these two colored lights for hyperopic, myopic and emmetropic eyes.

Gives Clear Images

THE following points may also be noted: (1) Because of the comparatively small amount of diffraction for blue light its effective power to give clear imaging for distances within the far point for blue is well recognized. This advantage is not had by deep red light. With respect to unclearness of imaging caused by diffraction, deep red light is the worst of the spectrum colors. (2) The disadvantage as to the coordination of accommodation and convergence is about equal for blue and red light. Complete coordination can be expected only for the wave-lengths in the mid region of the spectrum.

The complete coordination of convergence and accommodation is, it may be noted, very important to comfort, efficiency and speed in the use of the eyes. (3) it has been argued that red light light-adapts the eye less than blue light and that, therefore, the eye retains its sensitivity to light better under red light than under blue and that correspondingly red light has an advantage over blue in the seeing of objects. At the very low intensities in question this factor cannot be of very great importance. In any event in the test which we are recommending later in the paper in which exactly the same intensities of light are used in determining the distances at which the different colored lights can be seen as were used in giving equal visual acuities for these lights, this factor is fully taken into account. Furthermore, it does not seem that any difference in interference with subsequent trying to see in the dark could for lights of such low intensity be of any considerable importance. (4) Another argument that has been offered against blue light is that the color field is wider for blue than for red.

Confused Thinking

THE thinking here seems to be confused by the fact that, in general, vision in the peripheral field is important in aviation, particularly in combat aviation where objects of considerable visibility are involved. In this problem, however, the situation is very different. In the first place the far periphery of the retina is not blind to color. The limits of the color fields are a matter of the amount or intensity of the colored lights. In the second place the threshold of color sensation is so much raised in the peripheral field that the use of peripheral vision for the detection of colored light of threshold or near threshold intensity for central vision can not be of significant importance.

Finally, as far as color is concerned, a wider study by a test method that is direct and quantitative would probably show that the choice of colored lights is by no means limited to red and blue. Both have important disadvantages. For example, when all are equalized in intensity or in both intensity and saturation, red and blue at any level of intensity as compared with most of the colors give very poor visual acuity or power to see objects. This is a very important point indeed. Except as an emergency expedient or a matter of feasibility it would seem somewhat strange if a

choice between colored lights were to be limited to the two that give such poor power to see objects, particularly when the distance at which the lights can no longer be seen depends so much more on their intensity than their color.

In the test for both visual acuity and speed of discrimination the distance of the observer from the test-object was 20 feet. Because of poor focusing at 20 feet this distance was of course unfavorable for the colors at the blue end of the spectrum. Another factor in the poor results obtained for blue light was the small quality or sensation difference between the black test-object and its blue background.

It may seem strange that when the different spectrum lights are themselves made equally visible there should be such a difference in the visibility of the details illuminated by these lights. In explanation, the following points may be noted: a difference in the clearness of the images formed, a possible difference in the retina's power to make fine space discriminations for the different wave-lengths, and the sensation difference between the black test-object and the colored background. The complete picture of the eye's selectiveness of response to wave-length includes, then, definitely clearness of imaging, light and color sensation both as to quality and amount, and possibly the power of the retina to discriminate space for the different wave-lengths of light.

Choice to be Determined by Experiment

CLEARLY the choice can not be left to inference from scattered though related observations and experiments. It is a matter of direct test with as little as possible left to inference.

The problem is to select that color or composition of light that will be of the greatest use in the discrimination of detail in nearby objects, and will have the least visibility at a distance. The factors are the comparative visual acuities for different colors or compositions of light at a suitable low level of intensity, their power to penetrate the external atmosphere both clear and foggy, and their comparative visibilities in the dark at threshold intensities.

Using spectrum lights we have shown that when equalized in brightness or photometric intensity, they give a wide range of difference in visual acuity, the acuity being the highest in the mid region of the spectrum, and that this range and variation from point to point are different for different levels of intensity of light. That is, visual acuity is selective both to wave-length or composition of light and to intensity of light. We found this to be true also when the lights were equalized both in brightness and saturation of color. Some results of these determinations are given in the curves shown in Figure 3A. From an inspection of Figure 3A it can be readily understood that the intensity of the colored lights would have to be changed a great deal in relation to each other to give equal visual acuities, and that these changes of intensity would affect also greatly the distances at which they could be seen. The work was repeated using speed of discrimination, or speed of vision, as

the test instead of visual acuity, the speed of the eye's reaction being considered an important factor in the decision as to the comparative merits of the lights in question.

Mid-region of Spectrum Best

THE results of these tests are given in the curves shown in Figure 3B. Also using spectrum lights, equalized in energy, we have found that their visibility varies over a wide range, again being the highest in the mid region of the spectrum, and that the curve for visibility changes its shape for different levels of energy of light. That is, with respect to visibility, too, there is selectiveness to wave-length or composition of light, also to energy of light. These determinations

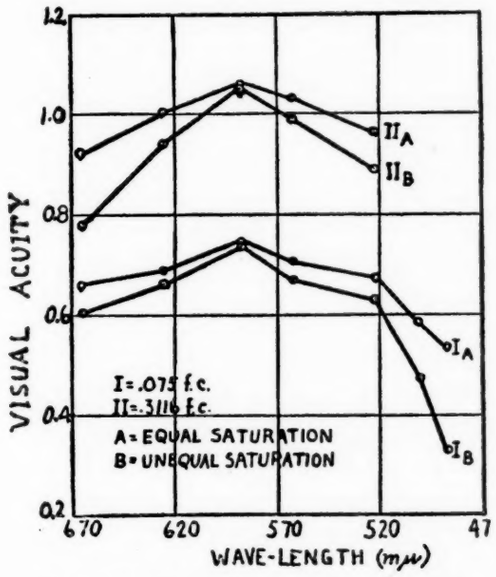

FIG. 3A. The effect of change of wave-length of light on visual acuity at 0.075 and 0.3116 footcandles, intensities I and II. Unequal and equal saturation series (3 observers).

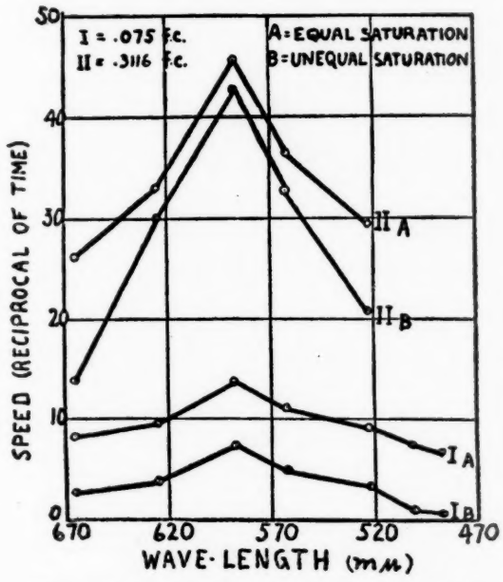

FIG. 3B. The effect of change of wave length of light on speed of discrimination at 0.075 and 0.3116 foot-candles, intensities I and II. Unequal and equal saturation series (3 observers).

were made by us with the light-adapted eye and under our direction with the dark-adapted eye. They constitute in effect a quantitative expression of the visibility changes that take place in what is commonly known as the Purkinje phenomenon.

The results are too numerous and too complicated to warrant space being given to them here. It will be sufficient perhaps to say that the results for both visual acuity and visibility render it absolutely clear that in any determination of the best light to use for wartime protection, the tests for visual acuity and visibility must both be made and under exactly the same conditions with respect to the significant factors which influence each, namely intensity of light and color or composition of light, and with a dark-adapted eye.

This can be most certainly accomplished by using the same illuminator and the same setting of its intensity control for testing the comparative distances at which the lights can be seen as was used in making the test for the comparative acuities. That is, the exact source of the illumination in the first case is made the test-object in the second case. In this way all difficulties and sources of error in the duplication of conditions in the two items of the test are completely eliminated, a very important one of which is that of securing equal intensities through photometering lights differing in color.

In order to make the test entirely direct, as should be the case, the intensity control of the illuminator should be set to give equal visual acuities at a suitably low level of intensity for each of the lights to be tested and the illuminator so adjusted be used, as noted above, as the test-object for the determination of the distance at which each light can be no longer seen. For a still closer correspondence with the conditions in actual use, the size of the test-object, the distance of the testee and the distance of the illuminator from the test-object should be chosen so that the intensities which are required to give equal visual acuities are somewhat akin to the minimum level that should be had in seeing one's way about in the dark. Perhaps 20 feet could be used as the distance of both the testee and the illuminator from the test-object.

> It is doubtless better to use also for both the testee and the illuminator a distance which is representative of near vision, for example a distance within the far point for blue light, and to base conclusions on the results of the tests for both distances. Unless results are obtained for distances that are representative of both far vision (20 feet or more) and near vision, it does not seem that a general conclusion can be safely drawn as to the merits of the lights in question. Further, objects and backgrounds present surfaces that have a wide variety of reflecting power. In order better to take into account the relationship of object to background as a factor in power to see objects, the intensities required to give equal visual acuities for the above-noted distances could, if thought best, be determined with both a black test-object on a white background and a white test-object on a black background, and these intensities also be used in determining the distances at which the lights can be no longer seen.

Recommendations for Testing

In our recommendation, however, full latitude is left on these points. In this way of making the test it should be clearly kept in mind that the size of the test-object, the distance of the testee and the distance of the illuminator from the test-object are kept constant, and the intensity of illumination is varied until the test-

object chosen can just be discriminated. Another possibility is to adjust the intensities of light in the illuminator such that the distance at which each colored light disappears is equal, and with this adjustment in case of each colored light to determine the comparative acuities. The difficulty with this method would be in the equipment that would be required to vary in continuous change the size or visual angle of the critical detail in any test-object that would be suitable for the purpose without changing the distance of the testee from the test-object.

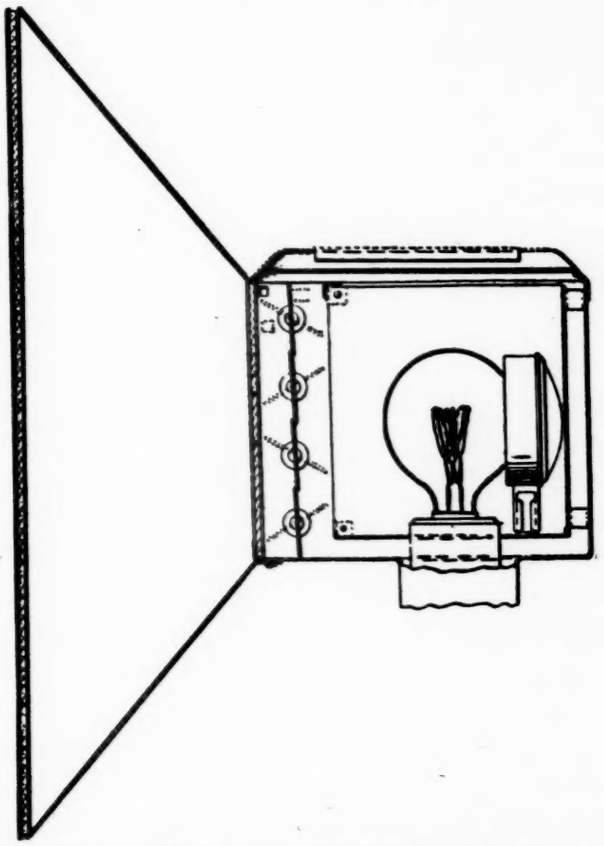

FIG. 4. The variable illuminator, vertical section. Vanes in closed position indicated by solid lines, partly open by dotted lines

The distance test should of course be made under more than one atmospheric condition—clear, foggy, etc. Inasmuch as changing the distance in making the test is the most troublesome and time-consuming part of the test, it may be found convenient to use as many illuminators as there are colored lights to be tested. This would enable the changes of distance to be made in a continuous series and would guarantee that the tests for the different lights are made under the same atmospheric condition.

Obviously the equipment used for making the test is very important to its success and its precision. The illuminator must be such, for example, that the changes of

intensity of light can be made in continuous series without changing the color or composition of the light, or the size, shape and location of the illuminated area. These requirements rule out the use of a rheostat or change of distance as means of changing the intensity, the rheostat in particular being unsuitable because of the changes which it causes in the color and composition of the light. The further requirement that the illuminator be made the test-object in the distance test would make inconvenient the use of a projection system with an iris diaphragm control such, for example, as is used in our Visual Acuity Projector. (Ferree, C. E. and Rand, G. "Testing Fitness for Night Flying. Visual Acuity." *Arch. of Ophthal.*, 1938, 20, pp. 58–79.)

The instrument we would recommend as being the most suitable in all respects is shown in Fig. 4. It may be called a Variable Illuminator.

Instrument Described

THE purpose of this instrument is to provide a means of varying the intensity of the illumination in continuous change from zero to any intensity that is wanted, without change in the color or composition of the light or in the size, shape or position of the illuminated area, and, if desired, to provide a means of correcting artificial light to light of daylight quality. The essential features of the instrument are a source of light of adequate intensity to give the range needed, a housing of suitable size and shape, a mechanical means or specially designed shutter for varying the intensity of the light, and a diffusing plate or other diffusing means both to eliminate completely the shadows which would otherwise be produced by the shutter and to give an evenly distributed and well diffused illumination of the test surface.

Movement of Vanes

THE means of varying intensity consists of four vanes which extend across the opening of the housing in such relation to each other that when their flat surfaces are parallel to the beam of light the maximum amount of light passes through the opening, and when they are rotated to a position at right angles to the beam the light changes in continuous series from full intensity to zero. In changing the intensity the vanes are so actuated as to cause contiguous vanes to turn in opposite directions. This insures that there will be no shift in the position of the illuminated area and no change in its size and shape. When the vanes all move in the same direction, as is the case with Venetian blinds, all these changes take place.

In various models of the instrument different means of actuating the vanes have been employed. In one model split gears were mounted on the ends of the axle pins of the vanes outside the housing, so adjusted as to take up all slack and backlash. In another a simple means has been devised which lies within the housing. It also is entirely free from slack and blacklash. This is in the form of a thin place with a

central longitudinal slot through which pass the axle pins at the ends of the vanes. This slot permits the plate to travel back and forth as the vanes turn. Above and below it in alternate sequence are short vertical slots which engage pins suitably positioned at the ends of the vanes. To the end of the axle of one of the vanes is attached a knob. When this knob is turned the contiguous vanes rotate in opposite directions as is desired.

No Shadows

IN ORDER that no shadow shall be cast by the vanes in any position in their rotation a plate of Belgian flashed opal glass is mounted directly in front of them, between them and the surface to be illuminated. In addition to eliminating completely all shadows on the illuminated surface, the provision secures exceptionally good diffusion of light. Behind the plate may be placed the color filter that is needed for obtaining the color selected to be tested.

While the flashed opal glass positioned directly in front of the vanes is sufficient to remove all trace of shadow from any surface to be illuminated at a distance of 5 inches or more, when looked at directly it is not itself seen as uniformly bright. Therefore, it could not be used as the test-object in making the distance test. In order to provide an evenly illuminated and evenly bright surface that can be used as the test-object in making the distance test, the construction of the housing is extended 5 inches beyond this plate of flashed opal glass and in its opening is mounted a second plate of flashed opal glass.

Distance Test

IN FIGURE 4 the aperture shown, purposely made to suit a wide variety of conditions, may be larger than is wanted in making the test. It can be given any size and shape that is desired by the use of suitable diaphragms. In making the distance test, for example, some may not find it convenient or even possible to use great distances, in which case the aperture can be made small, but always of the same size and shape for the different colors. In the construction of this extension we have felt that for many reasons latitude with respect to size and shape of this aperture was a desirable provision. The instrument so modified is used in making both the equalization of the visual acuities and the distance test. The front plate, then, of the instrument that is used in making the equalization of the visual acuities becomes the test-object or test surface for making the distance test, the intensity control having exactly the same setting for both tests.

The Double-broken Circle

AS THE most suitable test-object for making the equalization of the visual acuities we recommend the double-broken circle, the two breaks in which, 90 deg. apart, subtend each a visual angle of 1 min. This type of test-object has been made

into a chart which we have called the Double-broken Circle Visual Acuity and Astigmatism Test Chart. (Ferree, C. E. and Rand, G. "Testing Vision in the Industries." *Personnel J.*, 1939, 18, pp. 13–20. This chart can be obtained from Bausch and Lomb Optical Company, Rochester, N. Y.) Besides providing a more nearly absolute means of testing and rating vision, this chart comprises nineteen sizes of test-object, each size being presented in enough positions to test and accurately measure visual acuity in eight representative meridians—0, 45 deg., 90 deg., etc. This number of sizes, ten more than is ordinarily the case, renders the chart of especial value for selecting the size of test-object that is most suitable for making the present test. If desired, a single test-object of the size chosen can be used mounted on a rotatable dial with a remote control operated electromagnetically. The control we have devised for this purpose permits of the openings to be turned into and held in the eight representative meridians just noted,—0, 45 deg., 90 deg., etc.

The test we have recommended has the advantage of being both direct and quantitative, and the equipment of being, so far as we know, the most convenient and best suited to the purpose of any that has yet been devised.

Blackout Lighting in the Home

THE Variable Illuminator has also been made in the form of a lamp with the opening turned downwards or obliquely downwards. With its control of intensity by means of the rotatable shutter, the light can be varied in continuous change from full to extinction, thus making it possible by using it as a night light to obtain a complete blackout or as near a complete blackout as may be desired. In this lamp any color, type or wattage of bulb can be used, even the small neon night bulb. Suitably equipped, this lamp should serve a useful purpose in protective night lighting even to the total extinction of light for a complete blackout.

In this connection we wish to point out again the infeasibility of the ordinary blackout devices as an all-the-year round means of securing a complete blackout. In our southern cities the thought of obtaining a complete blackout of a fully lighted room on a hot summer night for any considerable length of time by means of curtaining or similar devices alone, is untenable and intolerable. We say this after more than thirty years of experience in light-proofing rooms and ventilating light-proofed rooms. The light-proofing of rooms as an all-year round project for the blackout without air conditioning, forced ventilation or a provision for natural ventilation with light-proofed devices seems to us not to be worthy of very serious consideration for the hot seasons of the year in hot climates.

Serious Problem in Hot Climates

THE blackout in the home is a very serious problem in this respect, and the home is the place where the greater part of our population stays at night. Very few

homes are provided with air conditioning, forced ventilation or light-proofed means of natural ventilation. The kind of blackout that is used in England, for example, is not suitable for use in summer in the southern portion of the United States. Again what is feasible in wintertime will not do for the summer months. In short, it would appear that the problem of the blackout should be attacked from two sides—the conventional light-proofing devices, and lighting.

The attack from the side of lighting can be made along two lines—color and composition of light, and intensity and direction of light. For the control of intensity of light a means for producing a finely graded and continuous change down to extinction is desirable and in some cases essential. Our strong feeling of need for this twofold attack on the problem of the blackout and protective night lighting is one of the incentives that has caused us to take up the subject of lighting in relation to the blackout. Surely it is not as dangerous to have the amount of light that is needed just to be able to see to get around in one room of a house with its sheltering roof and walls as it is to have enough light to see to get around out of doors in the open; and in any prolonged blackout a certain number of people have to be able to see to get around out of doors.

Book Reviews

Book Review Editor, Mr. Everett Van Every
California Personnel Management Association, Berkeley, Cal.

THE DYNAMICS OF INDUSTRIAL DEMOCRACY

By Clinton S. Golden and Harold J. Ruttenberg. Harper & Brothers. New York, 1942, 358 pp., $3.00

Reviewed by J. M. Trickett

Some have claimed this as "The most important book on labor ever published in this country"; others as " . . . the first systematic account of the reasons why organized labor believes it should have a more responsible role in the shaping of policy regarding restricted wartime production." Many readers will not wax so eloquent in their praise for all will not agree with the principles proposed and the conclusions drawn.

The outline of the book falls into three parts: Part One deals with union-management bargaining; Part Two is concerned with union-management cooperation; Part Three discusses union-management planning on industry-wide and national bases. The text is built around thirty-seven "principles of union-management relations."

These principles are enlarged upon, explained, and illustrated in detail, frequently in dialogue, from actual cases taken from the files of the United Steel Workers. Again, while many readers will not agree with all of these principles, representatives of labor and management alike will find them provocative of intelligent thought—perchance foreshadowing things to come in American industrial life.

The authors, prominent CIO officials, need no further introduction. Their work will stand for some time as an example of intelligent, verbalized labor leadership. It is a valuable contribution to those who handle labor problems at all levels.

WASHINGTON IS LIKE THAT

By W. M. Kiplinger. Harper & Brothers. 1942. 522 pp. New York. $3.50

Reviewed by Book Review Editor

If this volume has not already earned a place among the best-sellers, it certainly will. And if I am any judge of what readers will acclaim, I would rate this book high among the general interest books of our time.

Kiplinger, author of the well-known *News Letter*, has found time to compile one of the most interesting books you would ever want to read. Your knowledge of American history, of government affairs, of economics and sociology, of psychology and industrial relations will literally take on a wider scope of meaning and vitality with the reading of this account of the hub of American life. And yet the work is not a story of the life of a city . . . it is a greater job than that.

Every business man should know what makes America run. To some extent at least this book displays the working-drawings—the vital information on our whole economy. It is understandable, too, how many men can commute to Washington every few months to complain, appeal, or just grunt . . . and still not know the important things about Washington and what makes it go. In fact you will never know Washington, as it should be known, until you go around town with Kiplinger.

The author's style is not like his weekly newsletters—jerky and pointed, but rather relaxed and conversational as if he were pointing out the highspots to you. And you will meet the brass-hats about town, the dignitaries, the big-names, and the men who do and do not get things done. You will meet them on such intimate terms, with such blunt introductions, that the wonder of the whole thing is how any one person can talk this way, gather all the inside and outside information, and actually know so many people.

In the chapter on Post War Plans the reader is inclined to agree with Kiplinger's conclusion: "The economy of the future will be much different from that of the past, and it is toward the new economy that we are now heading."

Let us sit down with Kiplinger for a moment and recall a few experiences this interesting book affords:

> Washington is not merely the main hangout of party political workers and job holders. It is literally the nerve center of a vast political network which spreads out to every state and touches live cells in every county and town.
>
> Undoubtedly it is the gem city of the nation, and it ought to be, for it is a kept city, kept by the nation.
>
> The birthrate is not low, as you might expect in a city of working women. It is about average, which seems to prove something or other about working women.
>
> The big-name men—you can see them on the streets, or in the hotels, or at the baseball game, or scurrying into a store to get a clean shirt for tonight's affair. And yet you *don't* see them, for you don't know them by sight, and by and large neither does anyone else in Washington.
>
> The backwash of this war will leave thousands of such persons on the shores of Washington.
>
> Donald Nelson decided that small business should be used, not saved.
>
> Henderson's idea when he took over the price job was to hold prices together, not down. It was more than political pressure which made him shy away from wage control.
>
> Add up all the things the government is now doing in war production and the total is "economic planning."
>
> The United States Army is manned by soldiers all over the world, but is run from desks in Washington.
>
> *Parasite* (from chapter on Dialect of Washington): Term popularized by President Roosevelt in early 1942 to describe idle socialites and

> others who ought to get out of Washington to make room for government employees during war. Subsequently used by everyone to describe anyone whom Washington might well spare, resulting in an accumulation of suggestions which, if applied, would depopulate the city.

And yet for the life of me I cannot tell whether Kiplinger is a Republican or Democrat. This is really a rich example of contemporary reporting . . . a book that couldn't be half so interesting if it were devoted to all the other capitals of world combined. Washington is like that.